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AUTHOR DeVore, Paul W.
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ABSTRACT

Industrial education has reached the stage of evolution where a major transition is required if it is to continue as a viable field of education and contribute to the solution of some of society's significant and critical problems. If industrial arts practitioners are to guide their field through an orderly transformation, they must follow a different research agenda than the time-honored, traditional one. An examination of existing research dealing with industrial education reveals that it focuses primarily on how to teach rather than on what to teach. The research agenda for industrial education should be derived from problems grounded in two disciplines, technology and pedagogy. Included among the research problems that would be natural in this new agenda are questions related to work and its meaning, public policy concerning the adoption and use of new technologies, and the use and means of technical systems. (MN)

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Speaker:

Paul W. DeVore
Adjunct Professor
The Ohio State University

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Searching for Direction

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Research and Industrial Education Searching for Direction

Every aspect of education in American society is being examined today. So too is industrial education. As part of the process of self-examination, various professional groups meet to identify and explore the problems and issues. The purpose of this session is, according to the instructions I received, to (1) focus on central issues and problems facing our profession, and (2) to propose research to assist in the solution of the problems and issues.

Central to any discussion of this nature in the United States is the fundamental question of the purpose of education in a democratic society. Directly related to this question is the question of "What learning is of most worth?". This is the primary question. If these questions can be answered and a context for the answers established, then a beginning can be made on the question, "What research should the profession of industrial education be pursuing?".

The Purpose of Education

There are no final answers, nor is there one answer to the question of; "What is the purpose of education?". One's perception of purpose is related to one's world view. Thus, to pursue an answer to the questions of "What is the purpose of education?" and "What learning is of most worth?",

world views must be examined carefully, not in isolation, but within a context of the reality of the world as it is today and will probably be in the projected future.

We find, on examination, that the world today and in the projected future will be more technological, not less, that the population of the world is increasing, that there are limits to the resources of the world and the natural environment, and that we are in an era of transition, from a world of low entropy and orderliness to a state of high entropy and disorder. The latter factor, entropy, may be the most significant one of all. The mentality of the industrial era has been to produce, consume and grow. The result has been the creation of very inefficient and wasteful transformation and use processes with a built-in inflation that will only increase as we continue to use more and more of the dwindling resources. The fewer the resources, the higher the cost. The less concentrated a resource reservoir (copper, oil, or chromium, for instance) the greater the energy required to extract, process and recycle the resources.

Each of us is aware that we have entered a new era. The evidence surrounds us. Yet, for the most part, the primary purpose and focus of the field of industrial education has changed little. The primary concern, and even justification, is still job, career or occupational

preparation. This position is maintained even though there is considerable evidence that many programs are still preparing people for non-existing jobs and non-existing futures. This does not mean that work and jobs are not important nor that education to prepare for work is less important. The question is and always will be; "What knowledge and know-how is of most worth?".

One purpose of education should be to prepare people so they can adapt to new situations and control their own destinies. Our role as industrial educators should be to determine what learning is of most worth about industry and technology in an ever changing, dynamic, world-wide technological society. In pursuing this issue questions will range from, "What kind of technological society can we have given the limits of our natural world and the entropy law?" to, "How can we redesign and implement a system that, as a minimum, provides for the basic needs of each and every citizen, including the provision of meaningful roles in society?". An overall answer to this question will certainly focus on the need for all citizens in a democratic society to know about and understand the behavior of the various technological systems, sub-systems and their elements, so they can participate effectively in determining and controlling their collective futures. A democracy requires well-educated and knowledgeable citizens. The nature of education must be compatible with the present and projected society in which it exists.

Industrial education, born and nurtured in another era, is now in the position of examining the ways in which it contributes to these goals. The creation and development of technical means is of the intellect and the technical means of today are more intellectual not less, more theoretical not less, and more conceptual not less. It thus seems accurate to conclude that unless industrial education content and practice are based on theories and concepts relating to the behavior of the technical means and the relation of these means to human beings, their societies and the environment, that we cannot expect to educate citizens capable of creating and controlling technological systems.

Today, throughout our society, there is a recognition that the intellectual capabilities and technological understanding of our citizens must be enhanced if we are to compete successfully internationally and if we are going to manage successfully the technical, social, and environmental interfaces within our communities. We need not only intelligent and creative workers, but also intelligent and creative citizens. In what ways does the field of industrial education contribute to the education of intelligent and creative citizens for the world of today?

Over the years, one of the avowed missions of industrial education has been to study industry. The usual approach has been to find out what the practices were in

industry for designing or making a product and then to develop and teach curricula to emulate these practices. It would be difficult to make the case that such curricula actually provided a true study of industry in the same sense that other disciplines study the behavior of the phenomena of their fields. If the practitioners of industrial education had been involved in study and research about industry, then they would have been involved very early in environmental issues, worker health and safety, community and worker control of industries, microprocessor controls in industry, quality control through better design, employee adaptability to technological change, the enhancement of innovation and invention, and productivity questions, among others. But we were not. Our mentality is of an earlier industrial era, an era many do not want to admit no longer exists.

The evidence seems clear. We have reached that stage of evolution where a major transition is required if the field is to continue as a viable field of education and contribute to the solution of some of society's very significant and critical problems. In some places the transition has already begun, a transition forced by those external to the field. If we, as practitioners in the field, are to guide our field to an orderly transition, then we need to begin by searching for answers to a number

of fundamental questions. This will require a different research agenda than the time-honored, traditional one.

Research in Industrial Education

Most of the research in industrial education has been done as a requirement for doctoral and masters degrees. Reviews of research in industrial education have not attempted to evaluate the value of the research in terms of industry, technology and social problems, nor have they attempted to evaluate the quality of the research. Some reviews have cautioned researchers, in a limited way, about the selection of inappropriate statistical procedures and methodologies, but the critiques are few and limited.

Reviewing the research of the field by titles and place of origin provides some insight into uniqueness. For instance, one finding is that there seems to be no cumulative research base in the field. Each dissertation, even with the time honored requirement of extensive literature reviews, often stands alone, separate and isolated. Also, there does not seem to be agreed-upon research agendas, central themes or important problems. Nor does there seem to be an on-going identifiable network of researchers pursuing research on specific topics.

The categories of research have remained fairly constant over the years, probably because the focus of

research has been more on education and schooling than on industry. Categories such as history, philosophy, philosophical concepts, social and philosophical framework and goals and objectives of industrial education are usual, as are curriculum development, career development, instructional media and methods, facilities and equipment and teacher education, including organization and administration, undergraduate programs, graduate study, course development and recruitment. There has been considerable research on administration and supervision, leadership, public relations and program evaluation, including standards and status of the profession. Thus, another uniqueness of research in the field is that it is primarily education and public school oriented, not industry and technology oriented. This may be the source of the primary problem in the field, the fact that the research focus has been on the practice of teaching rather than on technology and industry. The issue of the practice of teaching is important but not primary. In fact, in order of priority, the issue of practice would be the last in a series of questions concerning curriculum design and implementation. The primary questions in order of importance are:

1. What to teach and why?
2. Who to teach it to and why?
3. When to teach it and why?
4. Where to teach it and why?
5. How to teach it and why?

For the most part, the first four questions are ignored. The primary research questions have not been directed toward answering the questions of, "what to teach and to whom?" but rather the question of "how to teach it?" The reason for this may be that the field of industrial education, as practiced, seems to be in general agreement on the answer to the question of, "What learning is of most worth?". This may be the source of the problem. Rarely have significant philosophical differences surfaced and been debated. Occasionally there have been journal articles and conference presentations which have attempted to begin the discussion. Most have not been taken seriously by the practitioners in the field and research in the field has not been of much help in contributing answers to the questions, primarily because most research has been conducted to fulfill degree requirements or to maintain positions on faculties in universities where research and publication are requirements. After individuals attain degrees in the field and assume professional employment, few continue research. Professionals occupying positions in public schools, two-year colleges and four-year colleges, on the whole, conduct little, if any, research. What research is conducted at the university level has had little affect on practice, except in isolated project sites or pilot programs. There are few instances where successful diffusion and adoption programs for the application of research to practice have been established.

One general conclusion that can be derived from observing the field and its behavior is that little change will take place without (1) a major shift in the philosophical base, and (2) a focus on the content of the discipline, rather than on education and the practice of teaching.

The new philosophical and content base can be evolved through a research effort based on the question: "What learning is of most worth in the study of industry and technology for citizens in their various roles in a democratic and highly technological society?". The question is highly relevant and significant. We are on the threshold of transitioning to another technological era brought about by a significant change in the energy supplies of the world. If industrial education is to contribute to the solution of the most critical problem of the modern era, energy and entropy, then research should be directed toward answering questions that relate to the on-going transition of industry and technology and the meaning of these changes to the education of citizens.

"What learning is of most worth?" There seems to be a developing consensus that the learning that is of most worth is:

that learning which serves individuals over the longest period of time and in the greatest number of situations as they live and participate in a meaningful and productive way in society.

The issue of intelligent citizenry is more critical than ever before. Being an intelligent citizen and worker today certainly involves knowing and doing in the technologies. Many recent choices with respect to our technical means have ended in disaster for some and near disaster for others. This is true whether the issue is toxic wastes from industrial processes or the disemployment of people when the primary industry in a community is closed, such as in Wierton, West Virginia and other similar towns and cities throughout the United States. People have come to realize that they have lost control of their lives and that the communities they once believed were stable and sustainable for the long-term future are vulnerable to decisions made thousands of miles from their communities. What we are discovering is that technological systems designed and developed by a mentality of another era are not sustainable. The problems and issues today concern the search for alternatives to present technical systems, either by designing new technical means or redesigning present ones. Successful designs will require new knowledge and understanding of the behavior of systems and the relation of the various elements and components of a system to the total. Today, our technical systems function on a global basis and decisions made by other businesses, industries, and governments affect directly business and industry in our own community.

Obviously, this requires, especially in a democratic society, the participation of all citizens if appropriate decisions are to be made and implemented. What learning is of most worth with respect to the design and control of technical means at the community level by citizens? At the regional or national level? Simply answered, it is the knowledge and know-how that has to do with the behavior of industrial and technological systems.

What should all citizens know about technical means? What should they be able to do? Obviously every citizen cannot know all there is to know about all of industry and technology. Therefore, the search must be for the structure of the discipline; the central themes, systems, concepts and principles that provide insight into the behavior of industry and technology, not only technically but in relation to, and within, social-cultural contexts. The goal is control of technical means by technologically literate human beings. The means to attain control is knowledge and understanding of the behavior of socio-technical systems.

This moves the educational focus from the craft or trade mentality to technology as a discipline and a science, in the same sense biology, psychology, sociology, and other fields of study are disciplines and sciences. This, of course, means rejecting the use of the word technology to

describe things, hardware, skills, industry, techniques or social phenomena. In most cases, a better descriptor would be technical means as used in this paper. For example, an automobile is a technical means created to transport people. Technology, as a discipline and as a science*, can then be defined as: the science of technical means and human adaptive systems, including the study of the creation, evolution, utilization and behavior of technical means and adaptive systems in relation to human beings, society and the environment.

What Research is of Most Worth?

The definition of technology provides clues to research, and scholarly activities that would be meaningful, cumulative, and have long-term application. For instance, studies concerning the creation and evolution of technical means and systems would provide insight into the relation of these means and systems to human beings and society, thus establishing data for the derivation of concepts and principles concerning their behavior.

Understanding how technical means are created would aid in improving our ability to design and create appropriate technical means for our communities. Research pertaining

* Science: Knowledge covering general truths or the operation of general laws especially as obtained and tested through scientific method. A system or method based on or purporting to be based on scientific principles.

to use of technical means and systems would provide insight into appropriate procedures as well as problems associated with the adoption and use of technical means by society. The latter knowledge could then be used in the design of alternatives to our present problem-plagued technological systems or for the redesign of current systems to attain a greater degree of compatibility with human beings, their communities, and the environment.

Research on the technical aspects of systems would focus on the behavior of material transformation processes. However, the operational behavior of systems and sub-systems would focus on techno-social relationships, perhaps one of the more difficult categories of research. In this research the concern would be the relation of technical means and systems to individuals, communities, work and employment, and the natural environment. Here the attempt would be to derive concepts and principles that could be used to predict the effect of the introduction of a new technical means into a social and natural context. Involved is the process of assessment and the prediction of probable impacts and risks.

Other research categories implied by the focus on technology as a discipline would be state of the art studies of evolving technical means and public policy studies concerning the adaption and use of new technologies. Included in the latter would be studies concerning employee

adaptability to technological change and the appropriateness of given technical means and systems with respect to quality of life and sustainability of communities. Questions related to work and its meaning and preparation for work would be natural research problems. For instance, what kind of education will all people require for work in the 21st century? When is the best time to prepare people for work? For specific jobs? What intellectual, physical and social skills are required?

Each of the above research efforts would contribute to the evolution of the content and structure of industrial education teacher education programs. This is a separate and distinct, yet related, research category that must be pursued.

Educational or pedagogical research questions must be redirected, the same as industrial and technological ones. The question of educating all people for the complex technological world they inhabit will require research concerned with the entire spectrum of education. Related to pedagogical research are questions concerning the diffusion and adoption of research findings and the design, development and evaluation of change models that can ensure the continued evolution of the field of education concerned with industry and technology.

Conclusion

The research agenda for industrial education should be derived from problems grounded in two disciplines, technology and pedagogy. This paper has focused on technology because, until this research is well underway, the "how to do it" research concerning pedagogy would have no purpose. Adopting technology as the discipline base for industrial education and directing pedagogical research to questions concerned with the content, structure, diffusion, adoption and teaching of the discipline will enable industrial education to continue to contribute in a unique way to American education.